MODEL 7031A

T1/T1C ERROR RATE MONITOR

Northeast Electronics Instruction Manual
A7031-10-600 Issue 1 April 1978

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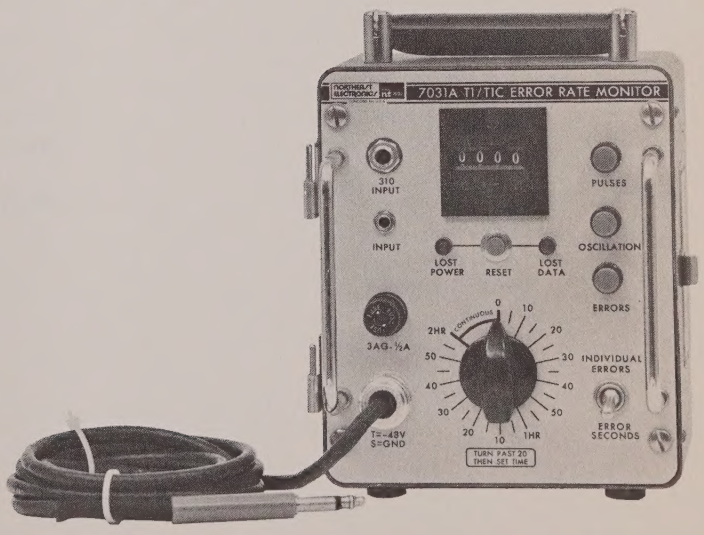

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TABLE OF CONTENTS

SECTION	TITLE	PAGE
1	**GENERAL DESCRIPTION**	1–1
	1.2 Special Features	1–2
	1.4 Power Requirements	1–1
2	**SPECIFICATIONS**	2–1
3	**INSTALLATION**	3–1
	3.2 Initial Inspection	3–1
	3.4 Return Material Authorization	3–1
	3.6 Power Connection	3–1
4	**OPERATION**	4–1
	4.2 Operating Procedures	4–3
	4.3 General	4–3
	4.5 Error Seconds Data Collection	4–4
	4.7 Individual Error Data Collection	4–5
5	**THEORY OF OPERATION**	5–1
	5.2 Overall Circuit Description	5–1
	5.4 Detailed Circuit Description	5–1
	5.5 Signal Input Circuit	5–1
	5.7 Input-To-TTL Converter	5–1
	5.9 Pulse Rate Circuit	5–1
	5.11 Pulse-Error Circuits	5–1
	5.16 Lost Data Circuit	5–2
	5.18 Oscillation Detection Circuits	5–2
	5.24 Power Supply And Lost Power	5–3
6	**MAINTENANCE AND CALIBRATION**	6–1
	6.2 Calibration	6–1
	6.3 Test Equipment Required	6–1
	6.5 Calibration Procedure	6–1
7	**DIAGRAMS**	7–1
8	**ELECTRONIC PARTS LISTS**	8–1

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
4–1	Model 7031A Front Panel Controls, Indicators, And Connectors	4–2
5–1	Pulse Error Detector Timing Diagram	5–2
5–2	All Ones Detector Timing Diagram	5–2
5–3	10 kHz Detector Timing Diagram	5–3
7–1	Model 7031A Circuit Board Component Location	7–2
7–2	Model 7031A Overall Schematic Diagram	7–3

LIST OF TABLES

TABLE	TITLE	PAGE
2–1	Model 7031A Specifications	2–1
4–1	Front Panel Controls, Indicators, And Connectors	4–1
8–1	Model 7031A Chassis Parts List	8–1
8–2	Oscillator And Error Detector Circuit Board Parts List	8–2

SECTION 1

GENERAL DESCRIPTION

1.1 The Northeast Electronics Model 7031A T1/T1C Error Rate Monitor is a portable test set capable of counting bipolar violations, error seconds, and of detecting oscillations at a monitor jack on a T1 or T1C office repeater. Error seconds may be counted continuously, or for a preset interval of up to two hours. The primary function of the 7031A is the collection of data for calculating the percentage of error-free seconds in a signal on a T1 or T1C transmission facility. Error-free seconds percentage is generally regarded as a criterion of excellence for digital transmission facilities. In addition, the 7031A indicates presence of oscillations and counts individual bipolar violations.

1.2 SPECIAL FEATURES

1.3 Data counts are displayed on an easily read, four-digit readout. An audible alert is sounded at the end of preset data collection intervals. The count is held without change until the display is reset manually. Confidence in accumulated data is enhanced by internal circuits which monitor input pulses and power for temporary losses. An interruption of either produces a visual indication. The 7031A detects both all ones (T1 only) and nominal 10-kHz line oscillations.

1.4 POWER REQUIREMENTS

1.5 The Model 7031A is powered by −48V central office battery. A 310 type plug on a permanently attached cable is inserted into an office battery jack to activate the test set.

SECTION 2

SPECIFICATIONS

2.1 Table 2—1 lists specifications for the Model 7031A T1/T1C Error Rate Monitor.

Table 2—1. Model 7031A Specifications

INPUT	
Signal:	From standard T1 or T1C office repeater MON jack (310 or bantam) using patch cord not more than 10 feet long.
Impedance:	Absolute value of 2100 ohms ±10% bridging at 1.544 MHz; input transformer dc blocked.
PULSE MONITORING	
PULSES indicator:	One flash per 100 milliseconds when input pulses are present (10 flashes per second). Indicator is inhibited during presence of 10 kHz oscillation.
LOST DATA indicator:	Activated by any inter-pulse interval of 1.3±0.5 seconds or more; remains active until manually reset.
ERROR MONITORING	
Counter Type:	Electromechanical with manual reset; maximum count is 9999.
Counter Timing:	Continuous or with automatic turn-off and audible signal after preselected period up to two hours.
Count Accumulation:	Counts up to 10 individual errors per second to 9999 total (INDIVIDUAL ERROR mode), or counts number of seconds in which at least one error occurred (ERROR SECOND mode).
ERRORS Indicator:	One flash per error, up to a maximum of 10 flashes per second.
OSCILLATION MONITORING	
All Ones Detector:	Oscillation producing approximately 150 or more consecutive ones is detected (for T1 only).
10 kHz Detector:	Oscillation at frequency lower than 23.5 kHz±5 kHz is detected.
OSCILLATION Indicator:	Activated by either type of oscillation; flashes ten times per second. The PULSES indicator flashes in unison with the OSCILLATION indicator for all ones oscillation.

Table 2—1. (Cont'd)

POWER REQUIREMENTS AND MONITORING	
Voltage:	−48 ± 6V central office battery.
Current:	300 milliamperes maximum.
LOST POWER Indicator:	Activated by momentary loss of power; remains active until manually reset.
AMBIENT TEMPERATURE RANGE	
Operation:	0°C to +60°C (32°F to +140°F).
Storage:	−20°C to +85°C (−4°F to +185°F).
PHYSICAL FEATURES	
Size:	6 in. w x 7 in. h x 6 in. d (15.2 cm w x 17.8 cm h x 15.2 cm d).
Weight:	4½ pounds (2 kg).

SECTION 3

INSTALLATION

3.1 The Model 7031A is a portable test set with no installation required.

3.2 INITIAL INSPECTION

3.3 The Model 7031A was carefully inspected, both mechanically and electrically, before shipment. It should be free of defects and should be operating correctly when received. To confirm this, the set should be inspected for signs of damage that may have occurred during shipment. If there is shipment damage, notify the carrier immediately. Electrical operation can be quickly checked in a central office by executing the operating instructions given in Section 4.

3.4 RETURN MATERIAL AUTHORIZATION

3.5 As detailed on the back side of the sales agreement, Northeast Electronics typically warrants instruments for a period of one year to the original purchaser. Before returning any piece of equipment to the factory for repair, a return material authorization number must be obtained from Northeast Electronics. To obtain this authorization, telephone the Customer Service Department at (603) 224-6511.

3.6 POWER CONNECTION

3.7 The Model 7031A test set operates from 48 Vdc office battery. Power connection is made through a 310 type plug on a cable permanently attached to the test set.

SECTION 4

OPERATION

4.1 The functions of front panel controls, indicators, and connectors (illustrated in Figure 4—1) are described in Table 4—1. Paragraphs 4.2 through 4.8 provide operating instructions.

Table 4—1. Front Panel Controls, Indicators, and Connectors.

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
DS1	PULSES indicator	Indicates presence of input pulses, flashes ten times per second. Inhibited by presence of 10 kHz oscillations
DS2	OSCILLATION indicator	Indicates presence of oscillations on input; flashes ten times per second.
DS3	ERRORS indicator	Fashes once per bipolar violation up to 10 per second.
DS4	LOST DATA indicator	Activates when T-carrier input signal is lost or is below threshold for 1.3 seconds or more. Remains active until reset by pressing RESET button.
DS5	LOST POWER indicator	Activates to indicate loss and subsequent restoration of —48V power to test set. Remains active until reset by pressing RESET button.
F1	3AG, ½ A fuse	Protects office repeater power circuits against excessive current drain by test set.
J1	INPUT jack	For connection to bantam type MON jack of T1 or T1C office repeaters. Length of cord should not exceed 10 feet.
J2	310 INPUT jack	Accepts 310-to-310 cord for connection to MON jack of T1 or T1C office repeater. Length of cord should not exceed 10 feet. Connection of J2 to test set circuits is interrupted if plug is inserted into J1.
M1	Counter	Counts individual errors or error seconds, depending on position of S1. Maximum count is 9999. Count is cleared to 0000 by pressing mechanical pushbutton on front of counter. CAUTION: DO NOT reset counter while counter is energized.

Table 4—1. (Cont'd)

REF DESIG	CONTROL,INDICATOR OR CONNECTOR	FUNCTION
M2	CONTINUOUS or 0 TO 2HR Timer	Controls counter M1 as follows: • De-energizes M1 when set to zero. • Allows continuous use of M1 when set to CONTINUOUS. • Allows use of counter for preset interval when set at a position clockwise from zero position.
P1	T= −48V, S= GND plug	Provides 310 plug on power cord for connection to −48V central office battery jack.
S1	INDIVIDUAL ERRORS/ ERROR SECONDS switch.	Selects individual data source for counter M1.
S2	RESET momentary pushbutton switch	De-activates LOST DATA and LOST POWER indicators DS4 and DS5.

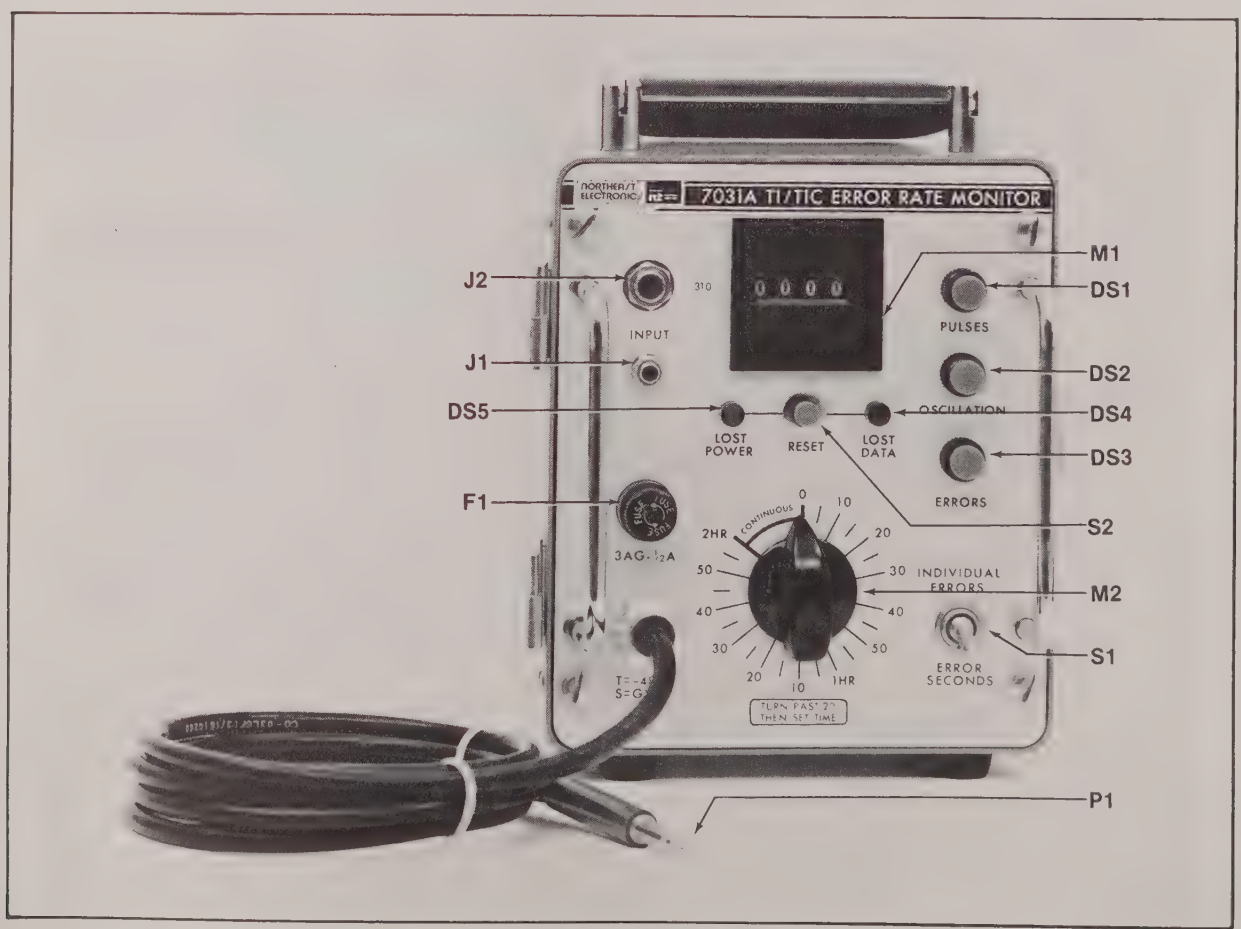


Figure 4—1. Model 7031A Front Panel Controls, Indicators, and Connectors.

4.2 OPERATING PROCEDURES

4.3 GENERAL

4.4 The Model 7031A is prepared for use as described below. General instructions for using the test set indicators are included.

ACTION	RESULT
a. Insert power plug on power cord into 310 type central office battery jack.	The LOST DATA and LOST POWER indicators light.
b. Use a patch cord to connect T1 or T1C office repeater MON jack to INPUT jack J1 (bantam) or J2 (310). Cord length must not exceed 10 feet.	
c. Press and release RESET pushbutton.	The LOST DATA and LOST POWER indicators go out.
d. Observe PULSES, ERRORS, and OSCILLATION indicators. NOTE These indicators are not affected by the INDIVIDUAL ERRORS/ERROR SECONDS switch.	A normal input signal will cause the PULSES indiator to flash ten times per second; the ERRORS and OSCILLATION indicators will be out. If there is no input signal (or if the input amplitude is below test set threshold), these three indicators will be inactive. If bipolar violations exist, the PULSES and ERRORS indicators will flash. The ERRORS indicator may flash sporadically or periodically at a rate up to ten flashes per second, depending on the nature of the error. If the all ones oscillations exist on the input, all three indicators will flash. If 10 kHz oscillations exist the OSCILLATION indicator will flash; the ERRORS indicator may or may not flash; the PULSES indicator will not flash.
e. Observe LOST DATA and LOST POWER indicators.	If the LOST DATA lamp lights, the input signal disappeared or fell below test set detection threshold for 1.3 seconds or more. Persistency of this fault can be assessed by pressing the RESET pushbutton and resuming monitoring of the indicator. If the LOST POWER lamp lights, the input power connection was momentarily faulty. Persistency can be assessed by pressing the RESET button momentarily and resuming observation. If the fault is associated with the power plug or central office battery jack, slight movement of the cable or plug may produce an active indication.

4.5 ERROR SECONDS DATA COLLECTION

4.6 The error-free percentage of operation time is 100 times the ratio of error-free seconds to total operating time. The Model 7031A does not count error-free seconds directly. Error-free seconds are calculated by subtracting error seconds, (which are counted by the Model 7031A), from the operating time over which the error second count is accumulated. The procedure for finding error-seconds and calculating the error-free percentage follows.

ACTION	RESULT
a. Make preliminary assessment of signal status as described in paragraph 4.3.	Measurement starts with general knowledge of signal status. (Ex: measurement would not ordinarily be made with oscillation present.)
b. Set TIMER at 0.	Assures that counter is de-energized before attempting reset.
c. Depress counter reset button.	Counter reads 0000.
d. Select ERROR SECOND position of INDIVIDUAL ERRORS/ERROR SECONDS switch.	
e. Set TIMER. If continuous data collection is required, rotate TIMER knob counterclockwise from zero into segment labeled CONTINUOUS. If data collection interval is to be preset, rotate timer knob clockwise to required interval. NOTE If the required interval is less than 20 (minutes), turn control clockwise past 20, then counterclockwise to required setting.	Counter advances one count for each second of operation in which a bipolar violation occurs in the input signal. Continuous collection is timed by using an external clock.
f. To terminate continuous collection, set TIMER to 0.	Halts count.
g. Upon expiration of preset collection interval or after executing step f, observe LOST DATA and LOST POWER indicators. Proceed if they are out (unlighted).	Count is not valid if either indicator is lighted. Repeat attempt to collect data or isolate fault.
h. Multiply original TIMER setting by 60 to obtain data collection interval in seconds. (Or find the interval of continuous operation in seconds.)	TIMER scale is in minutes; error-free percentage calculation is made in terms of seconds.
i. Subtract counter reading from step h result.	This yields number of error-free seconds.
j. Divide result of step i by that of step h.	This yields error-free ratio.
k. Multiply step j result by 100.	This yields error-free percentage.

4.7 INDIVIDUAL ERROR DATA COLLECTION

4.8 Individual error counts are accumulated to make a relatively quick check of the error rate on a T1 or T1C signal.

ACTION	RESULT
a. Make preliminary assessment of signal status as described in paragraph 4.3.	Measurement starts with general knowledge of input signal status. (Ex: measurements would not normally be made with oscillations present.)
b. Set TIMER at 0.	Assures that counter is de-energized before attempting reset.
c. Press counter reset button	Counter reads 0000.
d. Select INDIVIDUAL ERRORS position of INDIVIDUAL ERRORS/ERROR SECONDS switch.	
e. Set TIMER. If continuous data collection is required, rotate TIMER knob counterclockwise from zero into segment labeled CONTINUOUS. If data collection interval is to be preset, rotate TIMER knob to desired interval. NOTE If required interval is less than 20 minutes, turn control clockwise past 20, then counterclockwise to required setting.	Counter advances one count for each bipolar violation detected in the input signal (up to 10 per second).
f. To terminate continuous collection; set TIMER to 0.	Halts count.
g. Upon expiration of preset collection interval or after step f, observe LOST DATA and LOST POWER indicators. Proceed if they are out (unlighted).	Count is not valid if either indicator is lighted. Repeat attempt to collect data and/or isolate fault.
h. To find error rate, divide counter reading by collection interval (usually in seconds).	

SECTION 5

THEORY OF OPERATION

5.1 This section provides circuit descriptions for the Model 7031A T1/T1C Error Rate Monitor. The overall circuit description in paragraph 5.3 identifies the function of circuit groups. Detailed descriptions appear in paragraphs 5.5 through 5.26.

5.2 OVERALL CIRCUIT DESCRIPTION

5.3 Refer to Figure 7—2. Input signals from the T1 or T1C office repeater are modified to logic gating levels by the input-to-TTL converter. The presence of pulses is registered by PULSES indicator DS1, which is controlled by the pulse rate circuit (U10) and driven by a transistor pair (Q9,10). The pulse rate circuit limits DS1 to ten flashes per second. The pulse error detector (U2, 3) locates bipolar violations. Violations are indicated by DS3, controlled by the pulse error monostable circuit, which limits the flash rate to ten per second. Violations also trigger the error second monostable circuit (U8). This circuit maintains a maximum trigger rate of once per second. The INDIVIDUAL ERRORS/ERRORS SECOND switch selects the output of either the pulse error or error second monostable circuit for registration on counter M1. The counter is enabled by timer M2 and driven by a transistor pair (Q7,8). Detected input pulses continuously trigger the lost data circuit (U7, ½ U11). Loss of pulses for 1.3 seconds or more causes a latch to be set and DS4 to become active. That output of the input-to-TTL converter which is derived from positive input pulses feeds the all ones oscillation detector. When the rate of pulses to the detector becomes abnormally high, the detector output switches states. The output controls OSCILLATION indicator DS2. The 10 kHz oscillation detector switches state when the pulse rate drops below approximately 23.5 kHz. This circuit also controls DS2. LOST POWER indicator DS5 is controlled by a latch (lost power detector, ½ U11) which senses momentary loss of power.

5.4 DETAILED CIRCUIT DSCRIPTION

5.5 SIGNAL INPUT CIRCUIT

5.6 Refer to Figure 7—2. The T1 or T1C pulse train at 310 INPUT jack J2 enters the monitor circuit through build-out resistors R1 and R2 and transformer T1. The input cirucit is dc blocked by capacitor C1. The input bridging impedance is approximately 2100 ohms. Note that the 310 input is interrupted when signals are injected through INPUT jack J1.

5.7 INPUT-TO-TTL CONVERTER

5.8 This circuit detects positive and negative pulses separately and converts pulse voltages to TTL levels. Transistors Q1 and Q2 operate near the threshold of conduction in the quiescent state. A small amount of forward bias current is allowed by CR1 and R3. Positive-going pulses at Q1 and Q2 bases will allow Q1 and Q2 to conduct, but negative-going pulses will have a negligible effect. The secondaries of T1 are connected such that: (1) Q1 base sees a positive pulse only when the input signal pulse is positive, and (2) that Q2 base sees a positive pulse only when the input signal is negative. The pulses are thus separated. The outputs of Q1 and Q2 are inverted by U1D and C, respectively. The outputs of U1C and D (NEGPLS and POSPLS) are OR'd by U1B and inverted by U1A to produce a clock train that contains one pulse for each input signal pulse.

5.9 PULSE RATE CIRCUIT

5.10 The pulse rate circuit must indicate presence of pulses on the signal input but limit the indication to ten flashes per second. The flash rate is set by the time constant of U10A. With no input signal, U10A and B would remain in the reset state. The level at U10-11 would be high, a condition necessary to allow triggering of U10B. The first pulse to appear at U10-12 (from U1-1) would trigger U10B and produce a 50-millisecond positive pulse at U10-6. The leading edge of this pulse triggers U10A, which produces a 100-millisecond inhibit gate to U10-11. It is this gate that determines the maximum flash rate. The 50-millisecond pulse from U10-10 is gated by a quiescent high from U4-2 through U6B to inverter U4D, level converter Q9, driver Q10, and PULSES indicator DS1. The output of U4-2 switches low to disable DS1 when the 10 kHz oscillation mode is detected.

5.11 PULSE ERROR CIRCUITS

5.12 It is necessary to detect instances when the input pulses fail to alternate polarity (bipolar violations). Comparison of the polarities of two successive pulses requires a memory capability. The memory device in this circuit is U2. Circuit timing is shown in Figure 5—1. Paragraph 5.8 describes NEGPLS, POSPLS, and the clock. The J and K inputs are POSPLS and NEGPLS. The data on the J and K inputs are advanced to Q and $\bar{Q}$, respectively, on the trailing edge of the clock. Thus,

LASNEG (last pulse negative) goes high at the end of NEGPLS and LASPOS goes high at the end of POSPLS. Note that in the absence of bipolar violations, POSPLS never coincides with LASPOS and NEGPLS never coincides with LASNEG. The diagram shows two seccessive positive pulses (input pulses 8 and 9) following a series of normal pulses. Note that U2 is in the LASPOS state when the violating pulse appears. The logical product (POSPLS • LASPOS) appears as a pulse at U3-3. Two successive negative pulses would produce a pulse at U3-11. Either case becomes an error pulse at U3-6.

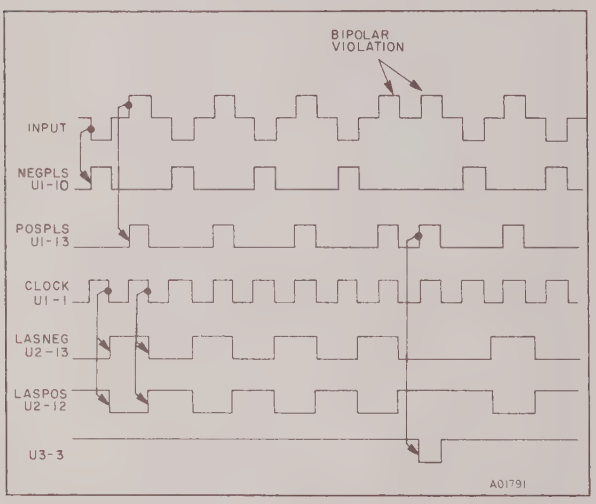


Figure 5—1. Pulse Error Detector Timing Diagram

5.13 The pulse error monostable circuit limits the pulse rate at ten per second and provides a pulse width appropriate for activation of ERRORS indicator DS3 and counter M1. Monostable multivibrator pair U9A and U9B is identical to U10A and B. The output at U9-10 (in response to error pulses from U3-6) is a 50-millisecond pulse at a maximum rate of ten per second. Transistors Q5 and Q6 connect the pulse to DS3.

5.14 The error second monostable circuit limits the error rate to one per second and provides a pulse width appropriate for activation of counter M1. Monostable multivibrator pair U8A and U8B is similar to U10A and B. In this circuit, the inhibit gate supplied by U8A is 1.0 seconds, set by R18.

5.15 Timer M2 includes a SPST switch which is closed in any position of the timer control other than zero. The switch connects counter driver Q7 and Q8 to counter M1. Each current pulse from the driver advances the counter by one count. Switch S1 connects the error rate circuit (INDIVIDUAL ERRORS) or the error second circuit (ERROR SECONDS) to the counter driver. Diode CR4 protects Q8 by damping the reverse voltage spikes produced at the end of each current pulse by the collapsing field around the counter solenoid.

5.16 LOST DATA CIRCUIT

5.17 Counted data are not considered to be valid if the signal input pulses are interrupted for 1.3 seconds or more. The pulse output of U1-1 continuously triggers U7A. The static low at U7-4 allows re-triggering. Only when input pulses are absent for an interval exceeding the "on" interval or U7A (1.3 ± 0.5 seconds) will the circuit switch to the reset state. When this happens, latch U11C,D sets and DS4 activates. The latch can be reset only by depressing RESET switch S2. Note that if the circuit is reset in the absence of input pulses, DS4 will become active immediately after the RESET button is released.

5.18 OSCILLATION DETECTION CIRCUITS

5.19 The input signal is monitored to detect two types of oscillation - the all ones and 10 kHz types. Each type is identifiable by inter-pulse intervals differing significantly from those found in normal T-carrier inputs. The all ones oscillation lacks the relatively long intervals that contain zeros. The 10 kHz oscillation produces abnormally long intervals between ones. Time constants of each detector are tailored to detect one type of oscillation.

5.20 The all ones detector differentiates between: (1) the random zeros that occur in pairs in a normal bit stream and (2) the all ones oscillation condition. The input circuit includes U4B, CR3, R9, and C5. When a one is present, U4B shunts CR3 to ground across C5 to discharge the capacitor. See Figure 5—2. During the interval between adjacent ones, CR3 is open for 0.97 microsecond and C5 charges toward ground through R9. This time is less than the R-C time constant of 1.09 microseconds and the voltage across C5 remains more negative than the —1.8 Vdc reference.

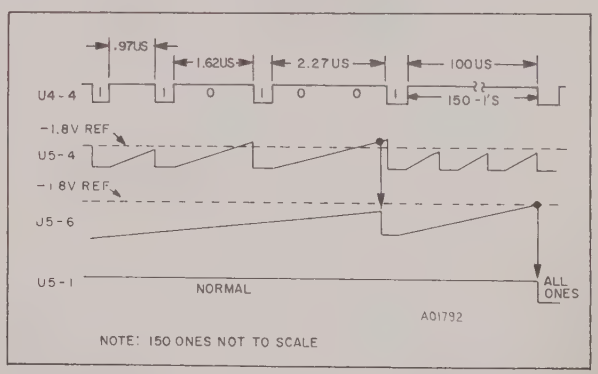


Figure 5—2. All Ones Detector Timing Diagram

5.21 During, the 1.62 microsecond interval of a single zero, the voltage across C5 exceeds the reference for a very short interval. The energy contained in the spike

above the reference is not large enough to trigger the comparator. The 2.27 micoseconds of consecutive zeros, on the other hand, has sufficient time to allow C5 to exceed the reference voltage and trigger the comparator. The comparator output then goes low and discharges C6.

5.22 The random pairs of zeros thus keep C6 discharged often enough so that the voltage across it does not exceed the −1.8 Vdc reference at U5-7. For the all ones condition, C5 is repeatedly discharged and the output at U5-2 is essentially an open. Capacitor C6 can now charge to ground and the voltage across the capacitor becomes more positive than the reference. The output at U5-1 switches to a low level, which is the all ones condition. Note that U3-9 is conditioned by the pulse rate circuit to cause a flashing indication.

5.23 Operation of the 10-kHz detector is similar to that of the all ones detector. Two comparators are biased by the same reference. The input and interstage circuits differ only in the time constants. Figure 5−3 shows the timing of this circuit. Typical sequences of ones and random zeros do not produce inter-pulse intervals sufficiently long to allow the voltage at U5-8 to cross the reference. The voltage at U5-10 remains above the reference with normal input patterns. The output at U5-13 remains low. Only when the input produces a relatively long (about 18 microseconds or more) interval between pulses will the voltage at U5-8 cross the reference and dump C4. With oscillation frequencies from 6 kHz to about 37.5 kHz, C4 will not be allowed time to again cross the reference. The circuit output at U5-13 remains high during such oscillatory conditions. Note that the sense of levels at U5-13 are opposite that at U5-1. The output of U5-13 is inverted by U4A to produce the appropriate sense.

5.24 POWER SUPPLY AND LOST POWER

5.25 The −5 volt dc power required to operate the logic circuits is derived from voltage regulator U101

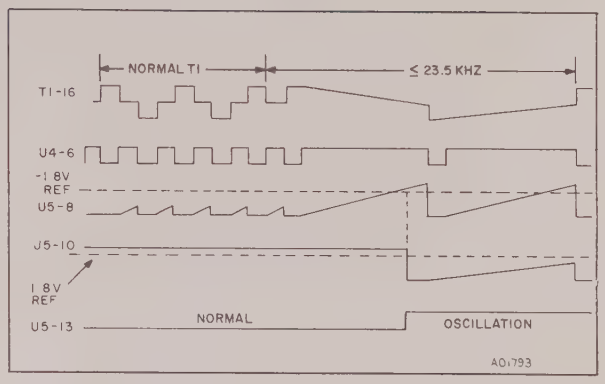


Figure 5−3. 10 kHz Detector Timing Diagram

and associated components. Primary power to the voltage regulator is supplied by the −48 volt central office battery, which is protected by 3AG, ¼ A fuse F1. Diode CR6 provides reverse polarity protection. Zener diode CR7 provides a reference voltage for Q1, which supplies the load current input to regulator U101. Capacitors C16 and C17 filter out transients that may be on the battery bus. Capacitor C18 provides output filtering.

5.26 Sections A and B of U11 make up the lost power latch. This circuit must produce a lost power indication when the test set is first activated. After being reset, the circuit must again produce this indication if input power is interrupted at any time during test set operation. When power is applied initially, the charge current of C15 (into U11-1) has the effect of making U11-1 low. The output at U11-3 will be high. The high level at U11-5 with the high at U11-4 produces a low at U11-6. This low activates DS5 and holds U11-2 low. The voltage at U11-1 quickly goes to zero (high) after the turn-on transient. The latch remains in this state until reset (manually). Capacitor C15 will discharge if the input power is interrupted. If power is restored, C15 again sets the latch and activates the LOST POWER indicator.

SECTION 6

MAINTENANCE AND CALIBRATION

6.1 No routine maintenance is prescribed for the Model 7031A. The calibration procedure is to be performed periodically (e.g., anually) or when a malfunction occurs.

6.2 **CALIBRATION**.

6.3 TEST EQUIPMENT REQUIRED

6.4 A Tektronix DC503 Electric Time Interval Counter (ETIC) or equivalent is required. Measurement accuracy must be 1% or better averaged over a 10-period interval. Also required is a T1 or T1C generator that produces deliberate bipolar violations such as the Northeast Electronics Models 7040 or 7001.

6.5 CALIBRATION PROCEDURE

6.6 This procedure relates to the adjustment of R18 on the printed circuit board. Calibration affects the accuracy of the error-seconds count. Figure 7—1 locates R18 and board terminals 1 and 10.

a. Loosen four retaining screws on front panel of Model 7031A and remove unit from case.

b. Connect power and T-carrier signal with bipolar violations to Model 7031A per paragraph 4.3.

c. Connect ETIC ground to card terminal 1.

d. Connect ETIC probe to card terminal 10.

e. Set up ETIC to measure period in milliseconds averaged over 10 periods.

f. If period is 1000 milliseconds ±5 milliseconds calibration is not required. If the period is out of tolerance, adjust R18 for a period reading of 1000 milliseconds. Apply glyptol to R18 adjustment screw when adjustment is complete.

g. Disconnect power, signal, and ETIC.

h. Secure unit to case.

- To verify physical operation of ALL INDICATORS
- use A 3314A @ 2Vpp, 10KHz, ⊓⊔, & hook it to 310 input
- ON power up: UUT should have Lost power + Lost DATA Cir
  press Reset & CONTINUOUS
- Rotate timing dial to continuous RANGE.
- With 3314A set AS ABOVE oscillation light should BLINK
- Set 3314A to 100KHz, errors & pulses should only be blinking Counter should REACT AS follow

"INDIVIDUAL errors" should count quickly (MAX 10 Hz counter RATE

"Error Seconds" one count per second

SECTION 7

DIAGRAMS

7.1 This section contains schematic and parts location diagrams for the Model 7031A T1/T1C Error Rate Monitor.

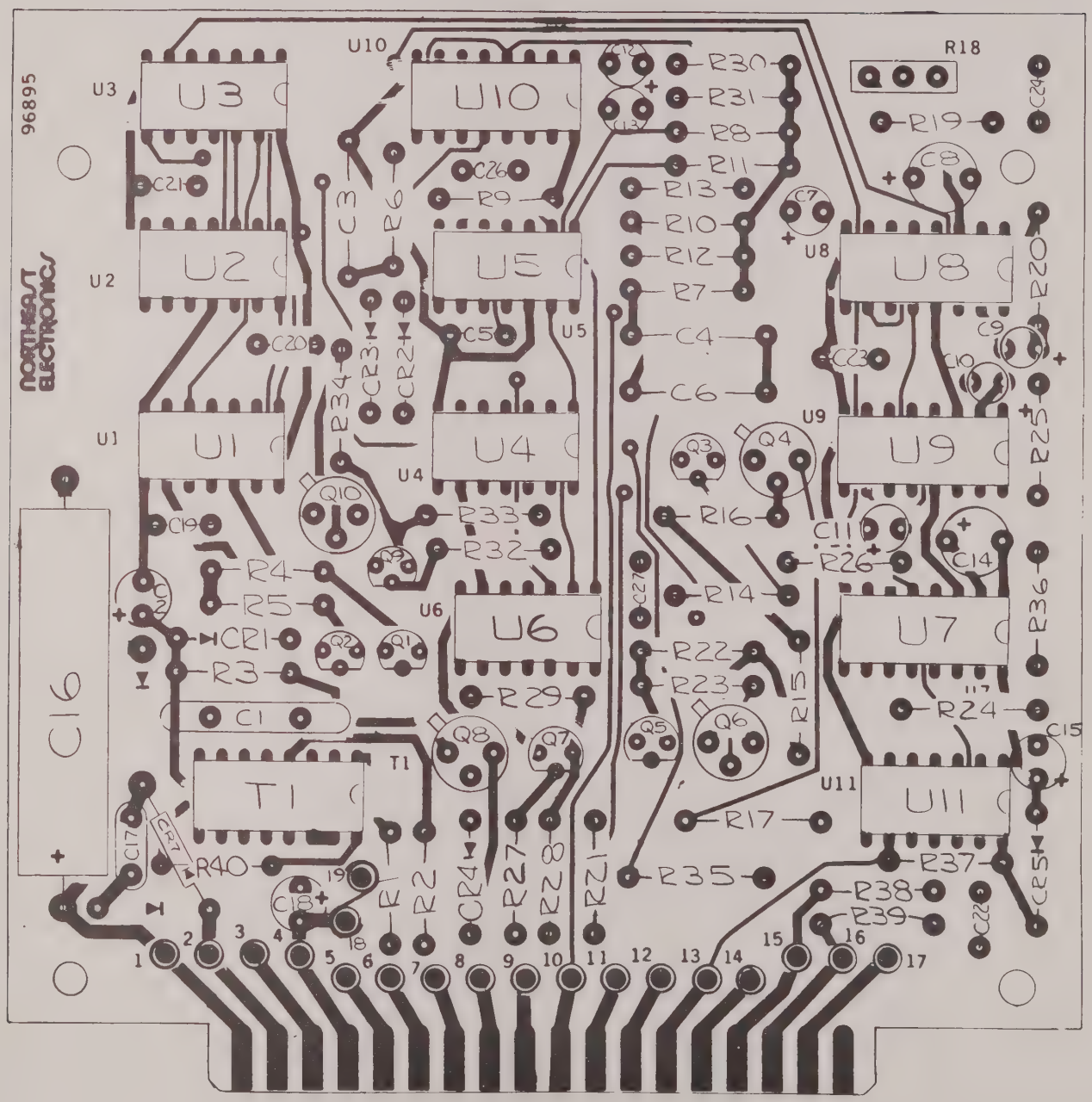
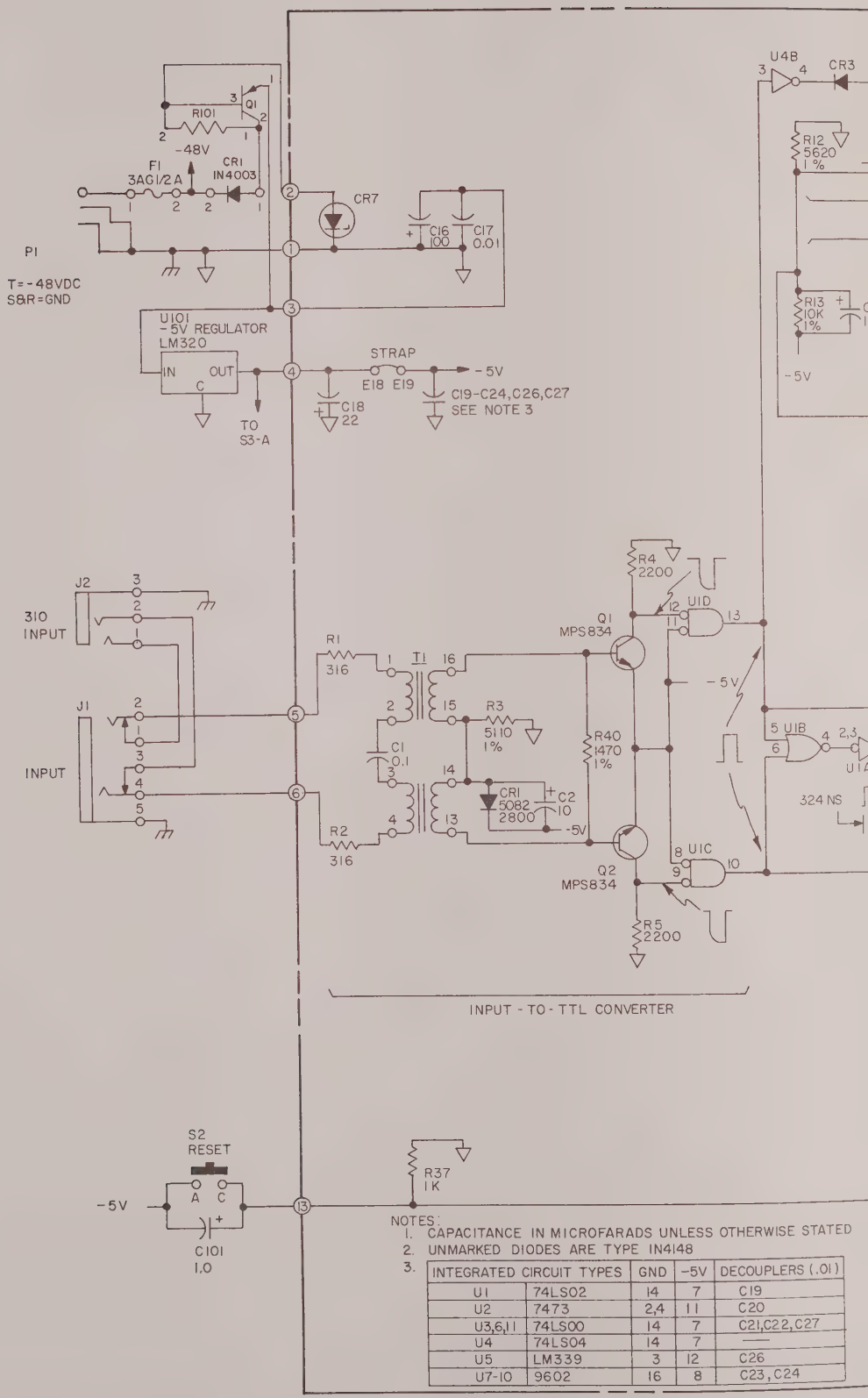


Figure 7—1. Model 7031A Circuit Board Component Location.



NOTES:
1. CAPACITANCE IN MICROFARADS UNLESS OTHERWISE STATED
2. UNMARKED DIODES ARE TYPE IN4148
3.

INTEGRATED CIRCUIT TYPES		GND	-5V	DECOUPLERS (.01)
U1	74LS02	14	7	C19
U2	7473	2,4	11	C20
U3,6,11	74LS00	14	7	C21,C22,C27
U4	74LS04	14	7	—
U5	LM339	3	12	C26
U7-10	9602	16	8	C23,C24

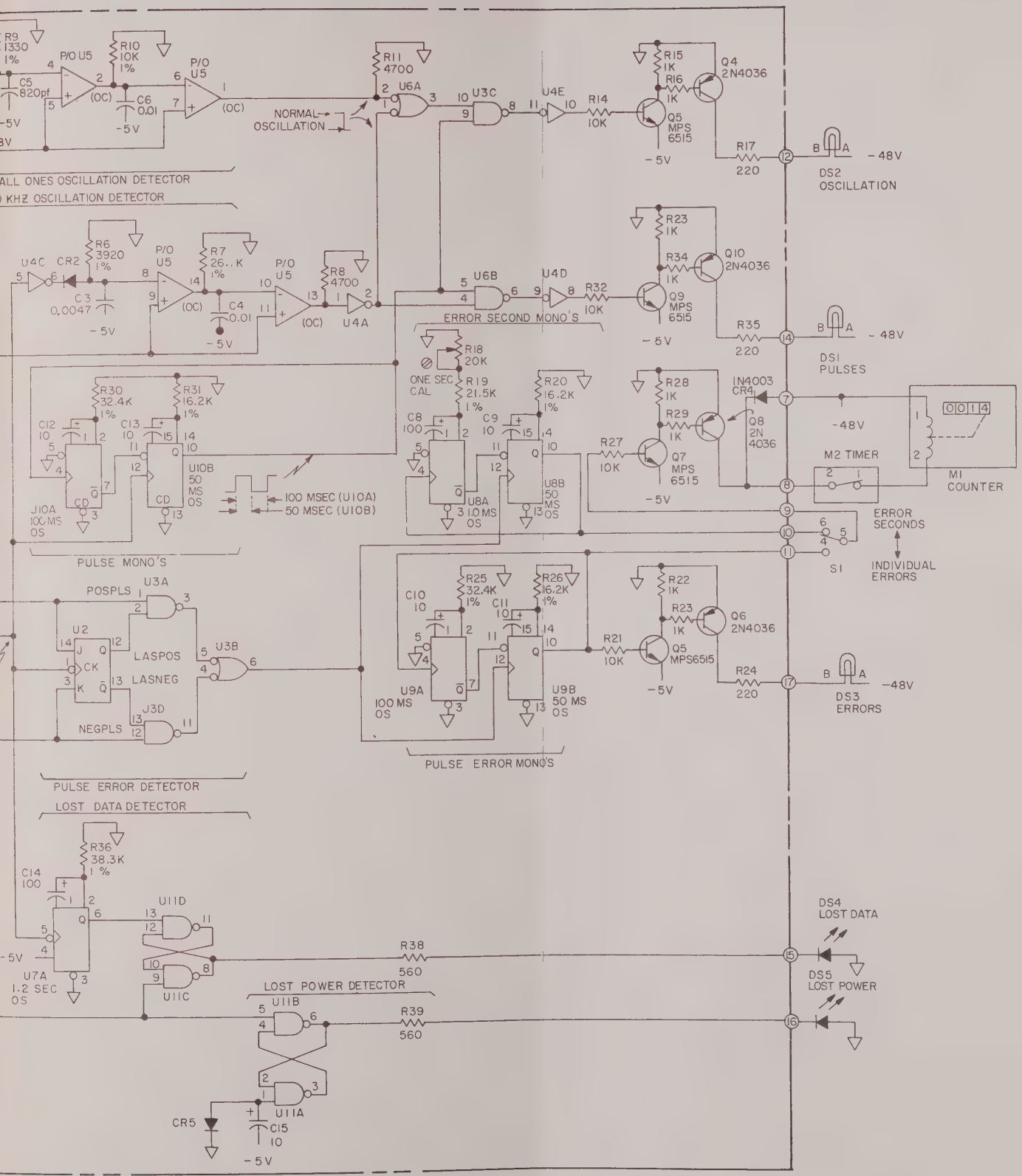


Figure 7—2. Model 7031A Overall Schematic Diagram

SECTION 8

ELECTRONIC PARTS LISTS

8.1 Electronic parts of the Model 7031A chassis and oscillator and error detector circuit boards are contained in this section.

Table 8—1. Model 7031A Chassis Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C101	1UF		10%	35V	KEMET	T330A105K035AS	310001051
CR1	D041	1A	SI	200V	EDAL	1N4003	560040030
DS1-3		40MA		48V	SYL	30941-5	730001800
DS4-5		10 MA			H.PACKARD	5082-4658	564500801
F1		.5A		250V	LITTELFUSE	3AG	863100300
J1	JACK,BANTAM				ADC	PJ839TS	650000001
J2	MT332B				SWCRFT	5J-1583	650403100
M1	CTR 4-DIGIT MAN RESET				DURANT	4-Y-41314-403-MFQ	728000600
M2	TIMER 2-HR W/HOLD+BELL				MH RHODES	71528-J	961200500
P1	6.5 FT 3W-18GA				LYNN ELEC	LGF3-18-6.5W	931900100
Q1	T-03	115W TC PNP		60V	MOTO/RCA	MJ2955	552029550
R101	1.2K	1W	10%		AB	TYPE GB	200301226
S1	DPDT	6A		125V	J-B-T	ST22N	620100600
S2	SPDT RED				SWCRFT	903	635400100
U1	TO-3	20W(MAX)	5%	-5V	NAT SEMI	LM320KC	500003200
XDS1-3	SOCKET,CART LAMP,SHORT				SYL	SM-1	828002000
XDS4-5	LED MTG. CLIP FOR T1 3/4				VISUAL COM	CLF-280-RTP	850501101
XF1	FUSEHOLDER,3AG PANEL				BUSSMAN	HKP	863000100
XU1	KIT XISTR MTG TO-3 PKG				KEYSTONE	4732	850501000

Table 8—2. Oscillator And Error Detector Circuit Board Parts List

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
C1	.1UF	DD	Z5U 20%	500V	SPRAGUE	5GA-P10	330401040
C2	10UF		B 10%	25V	SPRAGUE	196D106X9025KA1	310801061
C3	.0047MF		2%	50V	P-DYNE	PC12-.0047-50-2	322204720
C4	.01UF		1%	50V	P-DYNE	PC12-.01-50-1	322201030
C5	820 PF		5%	300V	ELMENCO	CM05-C821J0	335408210
C6	.01UF		1%	50V	P-DYNE	PC12-.01-50-1	322201030
C7	1 MF		A 20%	35V	SPRAGUE	196D105X0035HA1	310801050
C8	100UF		F 10%	10V	SPRAGUE	196D107X9010PE4	310801070
C9-13	10UF		B 10%	25V	SPRAGUE	196D106X9025KA1	310801061
C14	100UF		F 10%	10V	SPRAGUE	196D107X9010PE4	310801070
C15	10UF		B 10%	25V	SPRAGUE	196D106X9025KA1	310801061
C16	100UF			50V	SPRAGUE	TE-1309	300201072
C17	.01UF	DF	Z5U GMV	1KV	CENTRALAB	DD-103	330101030
C18	22UF		B 20%	10V	SPRAGUE	196D226X0010JA1	310802260
C19-24	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
C26-27	.01UF		20%	16V	CENTRALAB	UK16-103	330701031
CR1	OUTL.15	250MW		100P	H PACKARD	5082-2800	561550820
CR2-3	D035	4NS 10MA	SI	50UA	FAIRCHILD	IN4148	560041480
CR4	D041	1A	SI	200V	EDAL	1N4003	560040030
CR5	D035	4NS 10MA	SI	50UA	FAIRCHILD	IN4148	560041480
CR7	A1AY	1W	5%	22V	MOTOROLA	1N4748A	562047481
Q1-2	TO-18	360MW TA	NPN	15V	FAIRCHILD	2N2369A	550023691
Q3	TO-92	350MW TA	NPN	25V	MOTOROLA	MPS6515	550065150
Q4	TO5	7W TA	PNP	65V	RCA	2N4036	552040360
Q5	TO-92	350MW TA	NPN	25V	MOTOROLA	MPS6515	550065150
Q6	TO5	7W TA	PNP	65V	RCA	2N4036	552040360
Q7	TO-92	350MW TA	NPN	25V	MOTOROLA	MPS6515	550065150
Q8	TO5	7W TA	PNP	65V	RCA	2N4036	552040360
Q9	TO-92	350MW TA	NPN	25V	MOTOROLA	MPS6515	550065150
Q10	TO5	7W TA	PNP	65V	RCA	2N4036	552040360
R1-2	316-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220231601
R3	5110-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220251111
R4-5	2.7K	1/4W	10%		AB	TYPE CB	200102726
R6	3.92K	1/8W	1%		VPR	RN55 SIZE 25 PPM	221039211
R7	26.1K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220226121
R8	4.7K	1/4W	10%		AB	TYPE CB	200104726
R9	1330-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220213311
R10	10K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210021
R11	4.7K	1/4W	10%		AB	TYPE CB	200104726
R12	5.62K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220256211
R13	10K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210021
R14	10K	1/4W	10%		AB	TYPE CB	200101036
R15-16	1K	1/4W	10%		AB	TYPE CB	200101026
R17	220-	1/2W	10%		AB	TYPE EB	200202216
R18	20K	1/2W	10%	200V	HELIPOT	72XWR20K	232702031
R19	21.5K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220221521
R20	16.2K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220216221
R21	10K	1/4W	10%		AB	TYPE CB	200101036
R22-23	1K	1/4W	10%		AB	TYPE CB	200101026
R24	220-	1/2W	10%		AB	TYPE EB	200202216
R25	32.4K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220232421

Table 8—2. (Cont'd)

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
R26	16.2K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220216221
R27	10K	1/4W	10%		AB	TYPE CB	200101036
R28-29	1K	1/4W	10%		AB	TYPE CB	200101026
R30	32.4K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220232421
R31	16.2K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220216221
R32	10K	1/4W	10%		AB	TYPE CB	200101036
R33-34	1K	1/4W	10%		AB	TYPE CB	200101026
R35	220-	1/2W	10%		AB	TYPE EB	200202216
R36	36.3K	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220238321
R37	1K	1/4W	10%		AB	TYPE CB	200101026
R38-39	560-	1/4W	10%		AB	TYPE CB	200105616
R40	1470-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220214711
T1	16DILP				ARTTED	AC8326	440200100
U1	14 DIP-P			LS	T.I.	SN74LS02N	510907402
U2	14DIP-P			TTL	TI	SN7473N	510074730
U3	14 DIP-P			LS	T.I.	SN74LS00N	510907400
U4	14 DIP-P			LS	T.I.	SN74LS04N	510907404
U5	14 DIP				NAT.SEMI	LM339N	500000339
U6	14 DIP-P			LS	T.I.	SN74LS00N	510907400
U7-10	16DIP-P			DM3	FAIRCHILD	9602FC	510096025
U11	14 DIP-P			LS	T.I.	SN74LS00N	510907400

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